Space Weather Technical Forecast

Issued on Tuesday, 04 January 2022 at 00:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: No significant activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the past 24 hours, with only B-flares observed. There is one sunspot containing active region on the Earth-facing disc, a new unnumbered Bxo/Beta region in the southeast, however this is small and simple. AR2916 rotated off the Earth-facing disc as a Cho/Beta region.

No Earth-directed CMEs have been observed in the available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, observed by DSCOVR and ACE at L1, were initially around 450 km/s, but rose to became strong between 03/0500 UTC and 03/0700 UTC, with a peak of 621 km/s at 03/0525 UTC, before easing again to around 450-500km/s after 03/1600 UTC. Density was steady around 10-16 ppcc, but declined to below 8 ppcc at 03/1600 UTC. The interplanetary magnetic field strength, Bt, was generally weak, but had a brief peak of 9-10nT at 03/0900-1000 UTC. Bz became persistently negative from 03/0300 UTC to 03/0930 UTC, peaking -6nT, before rotating to be weakly positive. Phi angle has been mainly positive (away from the Sun), but with brief switches to negative before 03/0800 UTC. These parameters are consistent with a passing transient feature between 03/0400 UTC and 1600 UTC. Geomagnetic activity has been mostly Quiet to Unsettled (Kp 1-3), but an Active (Kp 4) interval was recorded 03/0300-0600 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. High energy electron flux (greater than 2MeV) has been background or moderate levels. Electron fluence was below the Active threshold, but with a gradual rising trend, with 1.46e7 integrated pfu recorded at 04/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Very Low or Low solar activity is expected, with only one small and simple sunspot on the disc. A new sunspot region is likely to rotate onto the disc on day 1 (4th) in the southeast, and there is a very slight chance of M-flares from the now far-sided AR2916 which could be observed on day 1.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Solar winds are expected to be easing to background with no notable enhancements expected through the forecast period. Geomagnetic activity will be mainly Quiet with only a slight chance of Unsettled intervals.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at background levels. High energy electron flux (greater than 2MeV) is increasingly likely to exceed the High (1e3pfu) level at diurnal peak as solar winds ease allowing the peak radiation belt flux to expand out to GEO. Electron fluence is also likely to rise through the forecast period, likely remaining below the Active level, but with a chance of rising above by the end of day 2 (5th).

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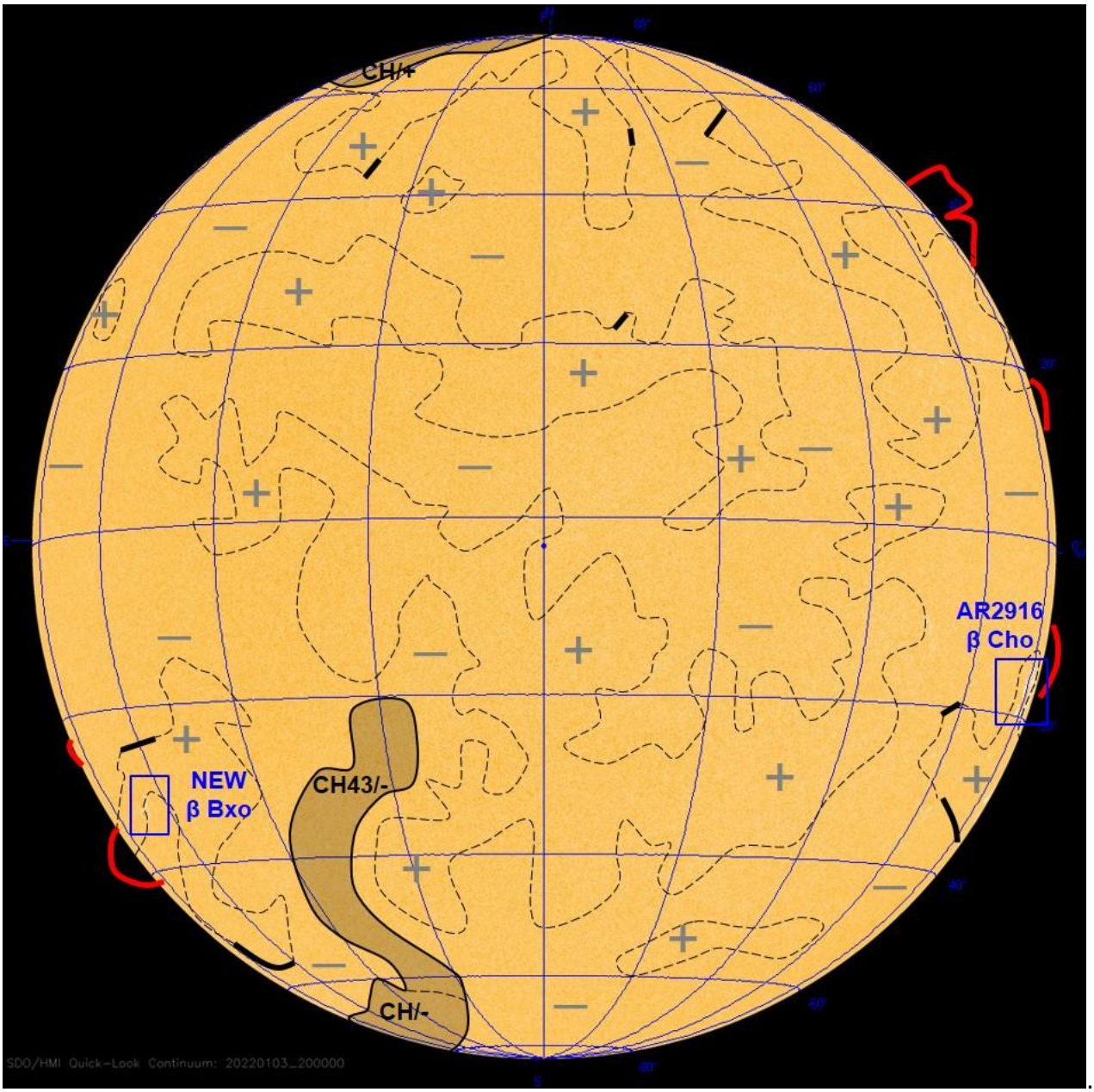
Figure 1. Solar Analysis Valid *.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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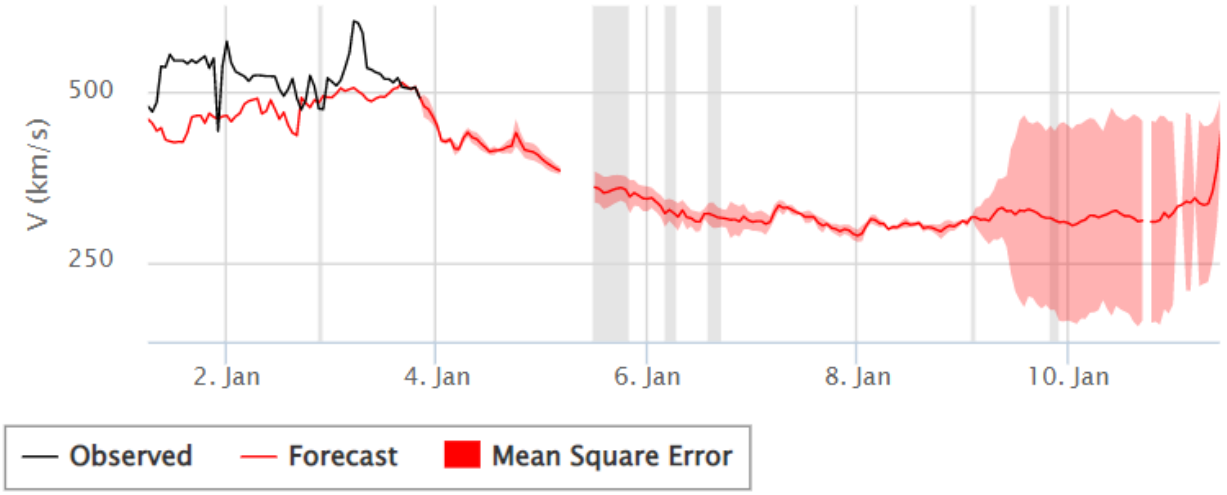
Geomagnetic Storms:

There no Earth-directed CMEs. Slight elevated solar winds are expected to continue easing through days 1 and 2 (4th and 5th), with mainly background winds persisting through the period. The next notable enhancement would be from the fast wind of coronal hole 43, which is not anticipated to arrive until beyond the forecast period.

Mainly Quiet geomagnetic activity is forecast, with only a slight chance of Unsettled intervals, mainly at first.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Solar Wind Persistence Model No significant enhancements expected.



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Radio Blackouts - X-Ray Flares:

Solar activity is currently Very Low, with only one small and simple sunspot on the visible disc. This is a small, recently emerged Bxo/Beta region in the southeast disc and unlikely to be a source of significant flaring unless further development occurs.

Despite this, a chance of C-flares and a slight chance of M-flares is maintained. AR2916 has only just rotated over the west limb horizon and onto the far side, and remains in a position where any notable flares are likely to be observable at least for day 1 (4th). Furthermore far-side helioseismic products indicate the potential for a new relatively strong region to rotate onto to the Earth-side from over the southwest limb through day 1. This is supported by a notable bright region visible on STEREO A euvi imagery.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16/17 X-ray Flux

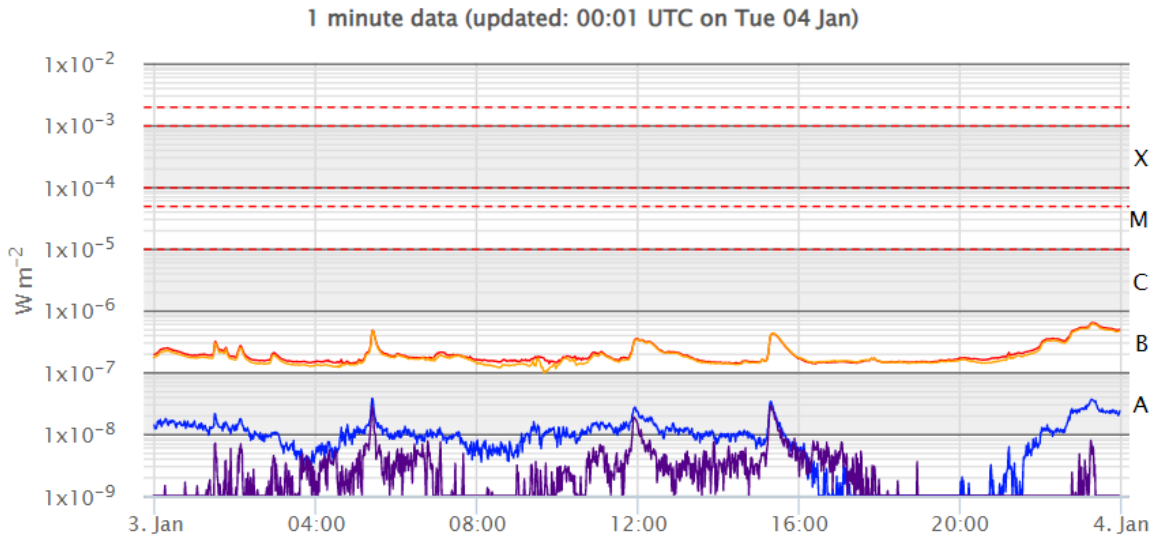

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Figure 4: STEREO A euvi imagery showing marked brighter region in SE soon to rotate onto Earth-side

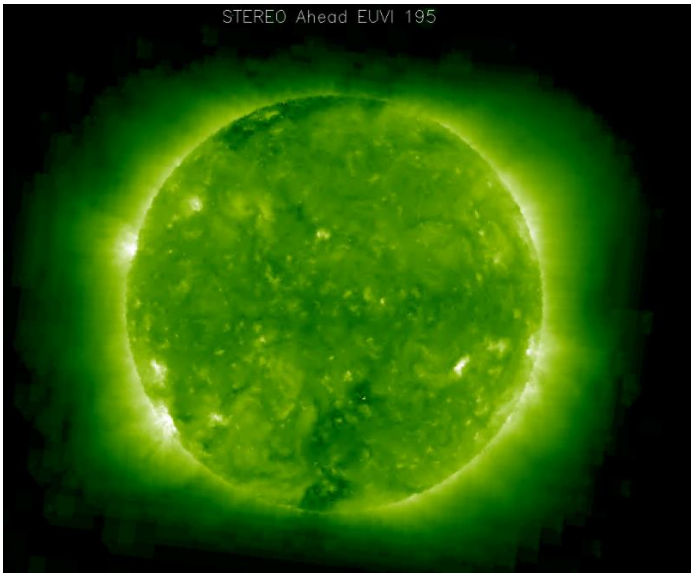
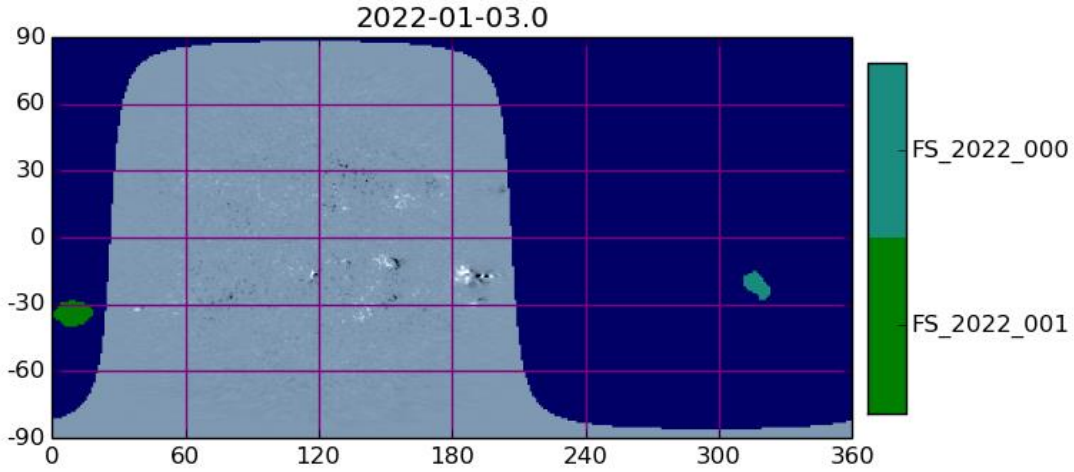


Figure 5: Helioseismic signal of far-side from jsoc.stanford.edu, marking potential active regions.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background levels and will most likely persist at this level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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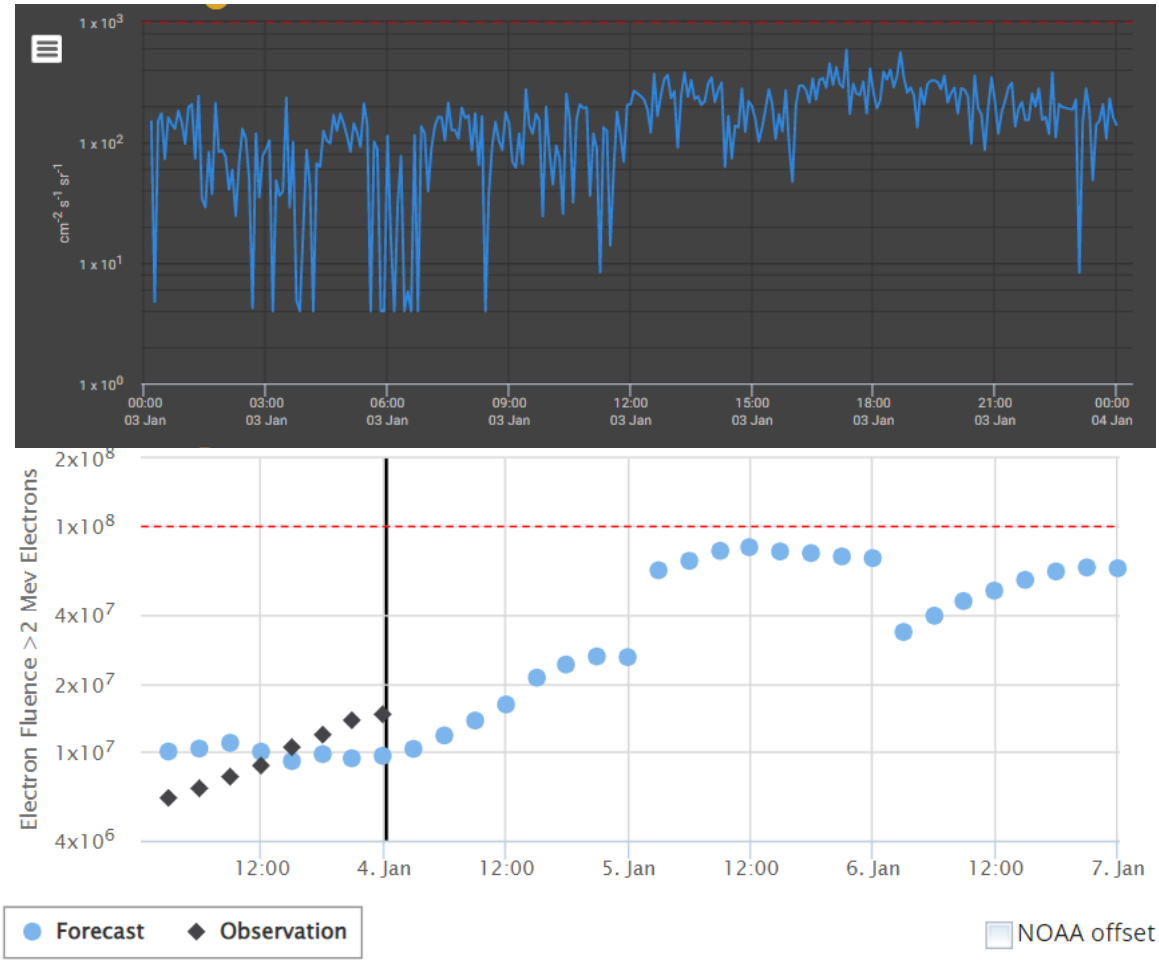
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 is currently at Moderate to Background levels, but is expected to exhibit a rising trend through days 1 and 2, as solar winds continue to ease. This will bring a chance of High levels being observed at diurnal peak.

The associated 24 hour fluence is currently below the Active (1e8 integrated pfu) threshold, but with a gradual rising trend. Whilst likely remaining below the active level, there is a chance of it rising above by the end of day 2 (5th). This is supported by REFM, which also has a rising trend, peaking just below Active on day 2 (5th).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	30	30	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 6: Currently GOES-16 >2MeV Electron Flux and associated 24hr Fluence with REFM



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